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(54) LENS APPARATUS AND IMAGING APPARATUS

LINSENVORRICHTUNG UND ABBILDUNGSVORRICHTUNG

APPAREIL A LENTILLE ET APPAREIL D'IMAGERIE

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EP 2 203 772 B1

Description

Technical Field

[0001] The present invention relates to a lens apparatus suitable for an imaging apparatus such as a compact digital camera.

BACKGROUND ART

[0002] Imaging apparatuses described above include one that has a zoom lens barrel having a zoom function which changes an imaging magnification by moving plural lens units (including a lens and its holding member) in an optical axis direction (see Japanese Patent Laid-Open No. 2001-324663).

[0003] In the zoom lens barrel disclosed in Japanese Patent Laid-Open No. 2001-324663, a plurality of lens units are moved in the optical axis direction by cams formed on a cam tube which can rotate around the optical axis. Here, a plurality of lens units are prevented from rotating so as not to rotate around the optical axis together with the cam tube. In other words, a plurality of lens units are driven in the optical axis direction by rotations of the cam tube while being guided in the optical axis direction.

[0004] Imaging apparatuses are desired to have a higher magnification ratio, but on the other hand they are required to be smaller and in particular thinner so that they can be easily carried around. A multistage stretching structure that shortens the size in the optical axis direction of each tubing member in the zoom lens barrel is conceivable for both the high magnification ratio and the low profile. However, the multistage stretching structure makes it difficult to arrange the cams for driving a plurality of lens units without interfering with each other.

[0005] Japanese Patent No. 3,842,087 discloses a zoom lens barrel provided with a first and a second cam for moving first and second lens units in the optical axis direction respectively on an outer circumferential surface and an inner circumferential surface of a rotation tube so that the first and second cams are provided without interfering (intersecting) with each other.

[0006] In the zoom lens barrel disclosed in Japanese Patent No. 3842087, the first lens unit and the second lens unit are respectively guided in the optical axis direction by separate tubing members (first and second linearly moving tubes). Therefore, relative decentering between the first and second linearly moving tubes is highly likely to cause similar decentering between the first and second lens units, too. In particular, since lens sensitivity has become high due to size reduction of the zoom lens barrel, even a slight decentering can largely influence the optical characteristics.

[0007] US 2004/0125225 discloses a lens apparatus capable of realizing better optical performance by suppressing an inclination of each lens unit more reliably while shortening the overall length in a collapsed position to the smallest possible level is disclosed. The lens apparatus comprises a fixed member which makes up the body of the apparatus, first and second lens holding members which hold their respective lens units and are movable in the direction of the optical axis with respect to the fixed member and a driving member which engages the first and second lens holding members and drives these first and second lens holding members in the direction of the optical axis.

[0008] US2007/195437 discloses a lens apparatus which has a small size but allows a higher magnification and an image-pickup apparatus including the lens apparatus are disclosed. The lens apparatus provides a variable magnification by moving a first lens and a second lens placed closer to an image plane than the first lens in the direction of an optical axis. The lens apparatus includes a first driving member which is rotated around the optical axis to move the first lens in the optical axis direction, a second driving member which moves the second lens by itself in the optical axis direction, and a driving mechanism which at least drives the rotation of the first driving member. The second driving member is moved in the optical axis direction relative to the first driving member by the rotation of the first driving member.

DISCLOSURE QF INVENTION

[0009] The present invention provides a lens apparatus that can achieve a high variable magnification ratio while minimizing relative decentering between a plurality of lens units, and an imaging apparatus that incorporates this lens apparatus. A lens apparatus according to the present invention as claimed in any of claims 1 to 3 herein.

[0010] Other features and advantages of the present invention will be apparent from the following description given in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a sectional view of a lens barrel (when stored).

FIG. 2 is a sectional view of the lens barrel (at a wide-angle end) of Fig. 1.

FIG. 3 is an exploded perspective view of the lens barrel of Fig. 1.

FIG. 4 is an exploded perspective view of the lens barrel according to an embodiment of the present invention.

FIG. 5 is an exploded perspective view of the lens barrel according to the embodiment of the present invention.

FIG. 6 is a perspective view of a camera (in power-off state) having the lens barrel of Figs 1 to 5.

FIG. 7 is a perspective view of the above camera (in

power-on state).

FIG. 8 is a top view of the above camera.

FIG. 9 is a back view of the above camera.

FIG. 10 is a bottom view of the above camera.

FIG. 11 is a block diagram showing the electrical structure of the above camera.

BEST MODE FOR CARRYING OUT THE INVENTION

[0012] Referring now to the accompanying drawings, a description will be given of an example of a camera and of an embodiment of the present invention.

Camera

[0013] FIGs. 6 to 10 illustrate the external appearance of a compact digital still camera as an imaging apparatus having a zoom lens barrel (lens apparatus). The camera 12 includes a zoom lens barrel (hereinafter referred to as "lens barrel") 100 that can change imaging magnification.

[0014] FIG. 6 shows the camera 12 in a power-off state, which is a state in which the lens barrel 100 is stored inside a camera body. FIG. 7 shows the camera 12 in a power-on state, which is a state in which the lens barrel 100 projects from the camera body (being capable of imaging). Further, FIGs. 8, 9, and 10 respectively show a top view, a back side view, and a bottom view of the camera 12. FIG. 11 shows the electrical structure of the camera 12.

[0015] As shown in these drawings, on a front side of the camera 12, a view finder 17 for determining a composition of an object, a light-emitting part 16 for emitting auxiliary light when measuring light and distance, a flash 18 for illuminating the object, and the lens barrel 100 are provided.

[0016] On an upper side of the camera 12, a release button 13, a power ON/OFF button 15, and a zoom switch 14 are provided. On a bottom side of the camera 12, a tripod attachment part 27 is provided, as well as slots for inserting a recording medium (card-type semiconductor memory) and a battery inside which are not shown are provided. These slots are covered by a cover 28.

[0017] Further, on a back side of the camera 12, operation buttons 21, 22, 23, 24, 25, and 26 are arranged so as to enable setting of various camera functions and switching of modes (still-imaging mode, moving-imaging mode, replay mode etc.). 20 is a display such as an LCD, and 19 is an eyepiece part of the view finder.

[0018] Referring to FIG. 11, the display 20 displays η image data generated by imaging and stored in a memory 40 or image data or the like read in from the recording medium.

[0019] A CPU 46, a ROM 45, and a RAM 47 are connected respectively to each of the release button 13, a drive control circuit 43, the operation buttons 21 to 26, the display 20, the memory 40, and a recording part 42 or the like via buses 44.

[0020] An imaging element 37 and the flash 18 are connected to the drive control circuit 43. The imaging element 37 is formed of a zoom motor drive circuit 29, a focus motor drive circuit 31, a shutter drive circuit 32, an aperture drive circuit 35, a CCD sensor, a CMOS sensor and the like. The drive control circuit 43 causes each of these circuits to operate in accordance with signals from the CPU 46.

[0021] The ROM 45 stores computer programs for the CPU 46 to control the various parts and circuits mentioned above. The RAM 47 stores data necessary for the control of the various parts and circuits.

[0022] When the power ON/OFF button 15 is turned on, the CPU 46 reads out a necessary program from the ROM 45 to start initial operation. At this time, the CPU 46 causes the lens barrel 100 to move from the stored state inside the camera body to the projected state (wide-angle state). When the zoom switch 14 is operated, the CPU 46 drives the lens barrel 100 in telescopic motion through the zoom motor drive circuit 29 to perform zooming by changing the distance between a first lens unit and a second lens unit to be described later.

[0023] When the release button 13 is half-pressed, the CPU 46 performs light measurement based on a signal from the imaging element 37, and determines an aperture value, shutter speed, and whether or not light emission of the flash 18 is necessary, based on a measured light value. The CPU 46 also measures the distance from the object, and drives a focus lens 30 (corresponding to the first and second lens units to be described later) through the focus motor drive circuit 31 to an in-focus position to achieve an in-focus state.

[0024] When the release button 13 is pressed down, the CPU 46 causes the aperture 34 to close through the aperture drive circuit 35, as well as causes the shutter 33 to perform open and close operation through the shutter drive circuit 32 to expose the imaging element 37. An output signal from the imaging element 37 is input to a digital signal processing circuit 39 through an analog signal processing circuit 36 and an A/D converter 38. The digital signal processing circuit 39 performs various processing to the signal input from the imaging element 37 to generate an imageg signal (image data). The image data is stored in the memory 40.

[0025] The image data stored in the memory 40 is compressed by a companding circuit 41 and stored in the recording medium through the recording part 42.

[0026] The image data is also displayed on the display 20. Next, the structure of the lens barrel 100 will be described using FIGs. 1 to 3. FIGs. 1 and 2 are sectional views of the lens barrel 100 respectively showing a stored state and a wide-angle state. FIG. 3 is an exploded perspective view of the lens barrel 100.

[0027] In FIGs. 1 to 3, 1 is a first lens unit, which is formed of a first lens and a tubular member holding the lens. Three cam followers Ib are formed such as to be spaced apart by 120° around the optical axis on an inner circumferential surface at a rear end part in the optical

axis direction (image-side end part) in the first lens unit 1. 2 is a second lens unit, which is formed of a second lens arranged on a side nearer to the image than the first lens and a member holding the lens. Three cam followers 2a are formed such as to be spaced apart by 120° around the optical axis on an outer circumferential surface at a rear end part in the optical axis direction (image-side end part) in the second lens unit 2. 3 is a cam tube (first cam tube) having three circumferentially formed first cam parts (cam groove parts) 3a on an outer circumferential surface thereof, with which the three cam followers Ib of the first lens unit 1 respectively engage. Three second cam parts (cam groove parts) 3b are circumferentially formed on an inner circumferential surface of the cam tube 3, with which the three cam followers 2a of the second lens unit 2 respectively engage.

[0028] A linearly moving guide tube 4 is arranged on an inner circumferential side of the cam tube 3. The cam tube 3 is rotatable around the optical axis along the outer circumferential surface of the linearly moving guide tube 4. On the other hand, the linearly moving guide tube 4 is fixed directly or via another member to a chassis (fixing member) which is not shown in the camera 12 so as to be prevented from rotating around the optical axis. On the inner circumferential surface of the first lens unit 1, guide groove parts Ia extending in the optical axis direction are formed at three circumferential locations. Three guide protrusions 4a formed on the outer circumferential surface at a front end part in the optical axis direction (object-side end part) of the linearly moving guide tube 4 respectively engage with the three guide groove parts Ia.

[0029] Guide protrusions 2b extending in the optical axis direction are formed on the outer circumferential surface of the second lens unit 2 at three locations with different phases from those of the cam followers 2a. The three guide protrusions 2b engage with guide groove parts 4b formed at three circumferential locations to extend in the optical axis direction of the linearly moving guide tube 4.

[0030] When the zoom motor drive circuit 29 shown in FIG. 11 rotates a zoom motor M connected thereto, the rotation is transmitted to the cam tube 3 via a power transmission mechanism (not shown) so as to rotate the cam tube 3 around the optical axis. The cam tube 3 rotates relative to the linearly moving guide tube 4. The rotation of the cam tube 3 gives a drive force respectively to the first and second lens units 1 and 2 in the optical axis direction and in a direction around the optical axis due to the cam effect between the first and second cam parts 3a and 3b and the cam followers Ib and 2a. At this time, the first and second lens units 1 and 2 are prevented from rotating around the optical axis by the guide groove parts Ia and the guide protrusions 2b respectively making engagement with the guide protrusions 4a and the guide groove parts 4b of the linearly moving guide tube 4. Therefore, the first and second lens units 1 and 2 move only in the optical axis direction.

[0031] According to this camera, the first and second lens units 1 and 2 are guided to move linearly in the optical axis direction by a single linearly moving guide tube 4 (in other words, they are prevented from rotating around the optical axis). Therefore, as compared to the case in which the first and second lens units 1 and 2 are guided in the optical axis direction by separate members as conventionally, relative decentering between the first and second lens units 1 and 2 is reduced. This accordingly improves the optical performance of the imaging optical system formed by the first and second lens units 1 and 2 and enables a high-quality image to be obtained by the camera 12.

[0032] Since the linearly moving guide tube 4 is arranged on the inner circumferential side of the cam tube 3, the diameter of the lens barrel 100 can be made smaller as compared to the case where it is arranged on the outer circumferential side of the cam tube 3.

[0033] While the imaging optical system is formed of two lens units in this camera, a third lens unit may be added, or four or more lens units may be used to form the system. χ g

EMBODIMENT

[0034] FIGs. 4 and 5 show the structure of a zoom lens barrel 100' that is an embodiment of the present invention. The zoom lens barrel (hereinafter referred to as "lens barrel") 100' of this embodiment is used in the camera 12 shown in FIGs. 6 to 10, too. FIGs. 4 and 5 respectively show a stored state and a wide-angle state of the lens barrel 100'. In the description below, constituent elements and parts identical to those in the embodiment are designated by the same designation numbers as those in the description of a camera detailed herein. The structure shown in FIG. 3 is basically common to this embodiment, and the constituent elements or parts that are not shown in FIG. 4 and FIG. 5 will be described using the designation number in FIG. 3.

[0035] 1 is a first lens unit, which is formed of a first lens and a tubular member holding the lens. Three cam followers Ib are formed such as to be spaced apart by 120° around the optical axis on an inner circumferential surface at a rear end part in the optical axis direction (image-side end part) in the first lens unit 1.

[0036] 2 is a second lens unit, which is formed of a ^ second lens arranged on a side nearer to the image than the first lens and a member holding the lens. Three cam followers 2a are formed such as to be spaced apart by 120° around the optical axis on an outer circumferential surface at a rear end part in the optical axis direction (image-side end part) in the second lens unit 2.

[0037] 5 is a third lens unit, which is formed of a third lens arranged on a side further nearer to the image than the second lens and a member holding the lens. Three cam followers 5a are formed such as to be spaced apart by 120° around the optical axis on an outer circumferential surface of the third lens unit 5.

[0038] 3 is a cam tube (first cam tube) having three circumferentially formed first cam parts (cam groove parts) 3a on an outer circumferential surface thereof, with which the three cam followers Ib respectively engage, and three circumferentially formed second cam parts (cam groove parts) 3b on an inner circumferential surface thereof, with which the three cam followers 2a respectively engage. Further, on the inner circumferential surface of the cam tube 3, three third cam parts (cam groove parts) 3c are circumferentially formed, with which the three cam followers 5a respectively engage.

[0039] A linearly moving guide tube 4 is arranged on an inner circumferential side of the cam tube 3. The cam tube 3 is rotatable around the optical axis along the outer circumferential surface of the linearly moving guide tube 4. On the outer circumferential surface of the linearly moving guide tube 4, guide groove parts 4d (see FIG. 3) extending in the optical axis direction are formed at two circumferential locations. Linearly moving keys βa formed to extend in the optical axis direction to a guide plate (guiding member) 6 attached to a fixed tube 9 that is fixed to a chassis (not shown) of the camera 12 engage with the guide groove parts 4d. This prevents the linearly moving guide tube 4 from rotating around the optical axis. The guide plate β engages with the fixed tube 9 such as to be movable in the optical axis direction while being prevented from rotating around the optical axis.

[0040] On the inner circumferential surface of the first lens unit 1, guide groove parts Ia extending in the optical axis direction are formed at three circumferential locations. Three guide protrusions 4a formed on the outer circumferential surface at a front end part in the optical axis direction (object-side end part) of the linearly moving guide tube 4 respectively engage with the three guide groove parts Ia. Guide protrusions 2b (see FIG. 3) extending in the optical axis direction are formed at three locations on the outer circumferential surface of the second lens unit 2. The three guide protrusions 2b engage with guide groove parts 4b (see FIG. 3) formed at three circumferential locations to extend in the optical axis direction of the linearly moving guide tube 4.

[0041] Guide protrusions (not shown) extending in the optical axis direction are formed at three locations on the outer circumferential surface of the third lens unit 5. The three guide protrusions engage with guide groove parts 4c (see FIG. 3) formed at three circumferential locations to extend in the optical axis direction of the linearly moving guide tube 4.

[0042] The cam tube 3 and the linearly moving guide tube 4 are rotatable relative to each other by a bayonet structure, and coupled to each other so as to be integrally movable in the optical axis direction. Since the linearly moving guide tube 4 is prevented from rotating as mentioned above, in practice, the cam tube 3 rotates relative to the linearly moving guide tube 4, and moves in the optical axis direction integrally with the linearly moving guide tube 4. A moving cam tube (second cam tube) 8 is arranged on an inner circumferential side of the fixed tube 9. A cam follower 8b is formed on an outer circumferential surface in a rear part in the optical axis direction of the moving cam tube 8, this cam follower 8b engaging with a cam part (cam groove part) 9a formed on the inner circumferential surface of the fixed tube 9. Further, a rotation transmitting protrusion 8a is formed on the outer circumferential surface in a rear end part of the moving cam tube 8. The rotation transmitting protrusion 8a engages with a drive ring 10, which is arranged on the outer circumferential side of the fixed tube 9 and rotatable around the optical axis relative to the fixed tube 9. Therefore, the moving cam tube 8 rotates with the rotation of the drive ring 10.

[0043] The moving cam tube 8 and the guide plate 6, too, are rotatable relative to each other by a bayonet structure and coupled to each other so as to be integrally movable in the optical axis direction. Since the guide plate 6 is prevented from rotating as mentioned above, in practice, the moving cam tube 8 rotates relative to the guide plate 6 and the fixed tube 9, and moves in the optical axis direction relative to the fixed tube 9 integrally with the guide plate 6.

[0044] A cylindrical member 7 as an external member is arranged on the outer circumferential side of the cam tube 3 and the first lens unit 1. The cylindrical member 7 forms an external appearance surface of the lens barrel 100' together with the moving cam tube 8, as well as closes a gap between the first lens unit 1 and the cam tube 3 to prevent penetration of dirt or dust from outside into the lens barrel 100'.

[0045] The cylindrical member 7 and the cam tube 3 are rotatable relative to each other by a bayonet structure, and coupled to each other so as to be integrally movable in the optical axis direction.

[0046] A cam follower 7a is formed on an outer circumferential surface in a rear end part of the cylindrical member 7, this cam follower 7a engaging with a cam part (cam groove part) 8c formed on the inner circumferential surface of the moving cam tube 8.

[0047] The cylindrical member 7 is guided in the optical axis direction (prevented from rotating around the optical axis) by the linearly moving keys 6b formed to the guide plate 6 to extend in the optical axis direction. Guiding the cylindrical member 7 to move linearly in the optical axis direction as described above rotates the moving cam tube 8, which in turn causes the cylindrical member 7 to move in the optical axis direction together with the cam tube 3 and the linearly moving guide tube 4 due to the cam effect between the cam part 8c and the cam follower 7a. At this time, the cam tube 3 moves in the optical axis direction while rotating around the optical axis, as it engages with the inner circumferential surface of the moving cam tube 8 to be rotatable integrally therewith at a protrusion part 3d. 11 is a cover tube, which covers the outer circumferential surface of the drive ring 10. The cover tube 11 is held by the fixed tube 9.

[0048] When the zoom motor drive circuit 29 shown in FIG. 11 rotates a zoom motor M connected thereto, the

rotation is transmitted to the drive ring 10 via a power transmission mechanism (not shown) so as to rotate the drive ring 10 around the optical axis. When the drive ring 10 rotates, the moving cam tube 8 rotates around the optical axis, as well as moves in the optical axis direction relative to the fixed tube 9 and the drive ring 10 due to the cam effect between the cam follower 8b and the cam part 9a of the fixed tube 9. The guide plate 6 also moves together with the moving cam tube 8 in the optical axis direction relative to the fixed tube 9.

[0049] When the moving cam tube 8 moves in the optical axis direction as it rotates, the cylindrical member 7 moves in the optical axis direction relative to the moving cam tube 8 as described above, which causes the cam tube 3 also to move in the optical axis direction together with the cylindrical member 7, while rotating integrally with the moving cam tube 8. The linearly moving guide tube 4 moves in the optical axis direction together with the cam tube 3 and cylindrical member 7 without rotating.

[0050] The rotation of the cam tube 3 gives a drive force respectively to the first and second lens units 1 and 2 in the optical axis direction and in a direction around the optical axis due to the cam effect between the first and second cam parts 3a and 3b and the cam followers Ib and 2a. The third lens unit 5 also receives a drive force in the optical axis direction and in a direction around the optical axis due to the cam effect between the third cam parts 3c and the cam followers 5a. At this time, the first, second, and third lens units 1, 2, and 5 are prevented from rotating around the optical axis by the guide groove parts Ia, the guide protrusions 2b, and the guide protrusions (not shown) respectively making engagement with the guide protrusions 4a and the guide groove parts 4b and 4c of the linearly moving guide tube 4. Therefore, the first, second, and third lens units 1, 2, and 5 move only in the optical axis direction.

[0051] According to this embodiment, the first, second, and third lens units 1, 2, and 5 are guided to move linearly in the optical axis direction by a single linearly moving guide tube 4 (in other words, they are prevented from rotating around the optical axis). Therefore, as compared to the case in which the first, second, and third lens units 1, 2, and 5 are guided in the optical axis direction by separate members as conventionally, relative decentering between these lens units 1, 2, and 5 is reduced. This accordingly improves the optical performance of the imaging optical system formed by the first, second, and third lens units 1, 2, and 5 and enables a high-quality image to be obtained by the camera 12.

[0052] Moreover, according to this embodiment, since the cam tube 3 and the linearly moving guide tube 4 are stretched out in the optical axis direction relative to the fixed tube 9, a lens barrel with a larger entire length, i.e., higher variable magnification ratio, than that of the lens barrel of the camera described herein can be realized.

[0053] While the present invention has been described with reference to exemplary embodiment, it is to be understood that the invention is not limited to the disclosed exemplary embodiment.

[0054] This application claims a foreign priority- benefit based on Japanese Patent Application 2007-261088, filed on October 4, 2007.

FIELD OF INDUSTRIAL APPLICATION

[0055] The present invention provides a lens apparatus that can achieve a high variable magnification ratio while minimizing relative decentering between a plurality of lens units, and an imaging apparatus that incorporates this lens apparatus.

Claims

1. A lens apparatus comprising:

a first lens unit (1) configured to hold a first lens and to be movable in an optical axis direction;
a second lens unit (2) configured to hold a second lens arranged closer to the image than the first lens and to be movable in the optical axis direction;
a first cam tube (3) configured to be rotatable around the optical axis, the first cam tube including a first cam part (3a) and a second cam part (3b), the first cam part engaging with the first lens unit on an outer circumferential surface of the first cam tube, and the second cam part (3b) engaging with the second lens unit on an inner circumferential surface of the first cam tube;
a linearly moving guide tube (4) including a first engagement part (4a) and a second engagement part (4b), the first engagement part engaging with the first lens unit (1) in an outer side of the linearly moving guide tube (4), and the second engagement part (4b) engaging with the second lens unit (2) in an inner side of the linearly moving guide tube (4),
a guide plate (6);
a cylinder member (7) arranged on an outer circumferential side of the first cam tube (3) and the first lens unit (1), the cylindrical member (7) including a cam follower (7a); and
a moving cam tube (8) having a cam part (8c) formed on the inner circumferential surface of the moving cam tube (8) and a cam follower (8b) formed on the outer circumferential surface of the moving cam tube (8), and a rotation transmitting protrusion (8a) formed on the outer circumferential surface of the moving cam tube (8);
wherein the first cam tube (3) engages with the inner circumferential surface of the moving cam tube (8) at a protrusion part (3d) to be rotatable integrally therewith;
wherein the first cam tube (3) and the cylinder member (7) are rotatable relative to each other

via a bayonet structure and are coupled to each other so as to be integrally movable in the optical axis direction,
wherein, in an inner circumferential side of the cylinder member (7), the first and second engagement parts (4a, 4b) and the first and second cam parts (3a, 3b) are configured to guide the first and second lens units in the optical axis direction while preventing from rotating around the optical axis,
wherein the guide plate (6) is attached to a fixed member (9) so as to be movable in the optical axis direction while being prevented from rotating around the optical axis, and is arranged, by a bayonet structure, to be integrally movable with and rotatable relative to the moving cam tube (8),
wherein the moving cam tube (8) is arranged on an inner circumferential side of the fixed member (9) having a cam part (9a), the rotation transmitting protrusion (8a) being arranged to engage with a drive ring (10) and the cam follower (8b) being arranged to engage with the cam part (9a) on the fixed member (9), and
wherein the cam follower (7a) of the cylindrical member (7) engages with the cam part (8c) of the moving cam tube (8) such that movement of the moving cam tube (8) by the drive ring (10) causes the cylindrical member (7) to move in the optical axis direction together with the first cam tube (3) and the linearly moving guide tube (4).

2. A lens apparatus according to claim 1, further comprising a third lens unit (5) configured to move in the optical axis direction,
wherein the first cam tube (3) includes a third cam part (3c) formed on the inner circumferential surface of the first cam tube and configured to move the third lens unit in the optical axis direction, and
wherein the linearly moving guide tube wherein the linearly moving guide tube (4) guides the third lens unit (5) in the optical axis direction.

3. An imaging apparatus including a lens apparatus according to any one of claims 1 or 2.

Patentansprüche

1. Objektiv, umfassend:

eine erste Linseneinheit (1), konfiguriert, eine erste Linse zu halten und in einer Richtung der optischen Achse bewegt werden zu können;
eine zweite Linseneinheit (2), konfiguriert, eine zweite, näher am Bild als die erste Linse angeordnete Linse zu halten und in der Richtung der optischen Achse bewegt werden zu können;
einen ersten Nockentubus (3), konfiguriert, um die optische Achse gedreht werden zu können, mit einem ersten Nockenteil (3a) und einem zweiten Nockenteil (3b), wobei das erste Nockenteil und die erste Linseneinheit an einer Außenumfangsfläche des ersten Nockentubus ineinandergreifen und das zweite Nockenteil (3b) und die zweite Linseneinheit an einer Innenumfangsfläche des ersten Nockentubus ineinandergreifen;
einen linear beweglichen Führungstubus (4) mit einem ersten Eingriffsteil (4a) und einem zweiten Eingriffsteil (4b), wobei das erste Eingriffsteil und die erste Linseneinheit (1) an einer Außenseite des linear beweglichen Führungstubus (4) ineinandergreifen und das zweite Eingriffsteil (4b) und die zweite Linseneinheit (2) an einer Innenseite des linear beweglichen Führungstubus (4) ineinandergreifen,
eine Führungsplatte (6);
ein an einer Außenumfangsseite des ersten Nockentubus (3) und der ersten Linseneinheit (1) angeordnetes Zylinderelement (7) mit einem einen Nockenfolger (7a); und
einen beweglichen Nockentubus (8) mit einem an der Innenumfangsfläche des Nockentubus (8) gebildeten Nockenteil (8c) und einem Nockenfolger (8b) auf der Außenumfangsfläche des beweglichen Nockentubus (8) sowie einem auf dessen Außenumfangsfläche gebildeten drehungsübertragenden Vorsprung (8a),
wobei der Nockentubus (3) an einem Vorsprungsteil (3d) mit der Innenumfangsfläche des beweglichen Nockentubus (8) im Eingriff ist, um zusammen damit gedreht werden zu können;
wobei der erste Nockentubus (3) und das Zylinderelement (7) relativ zueinander über eine Bajonettstruktur bewegt werden können und derart miteinander gekoppelt sind, dass sie zusammen in Richtung der optischen Achse bewegt werden können,
wobei an einer Innenumfangsseite des Zylinderelements (7) das erste und das zweite Eingriffsteil (4a, 4b) und das erste und das zweite Nockenteil (3a, 3b) konfiguriert sind, die erste und zweite Linseneinheit in Richtung der optischen Achse zu führen und zugleich eine Drehung um die optische Achse zu verhindern,
wobei die Führungsplatte (6) an einem Festelement (9) derart angebracht ist, dass sie in Richtung der optischen Achse bewegt werden kann und gleichzeitig am Drehen um die optische Achse gehindert wird, und durch eine Bajonettstruktur derart ausgebildet ist, um mit dem Nockentubus (8) zusammen bewegt und relativ zu ihm gedreht werden zu können,

wobei der bewegliche Nockentubus (8) an einer Innenumfangsfläche des Festelements (9) samt einem Nockenteil (9a) angeordnet ist, wobei der drehungsübertragende Vorsprung (8a) derart ausgebildet ist, dass er mit dem Antriebsring (10) im Eingriff steht und der Nockenfolger (8b) derart ausgebildet ist, dass er mit dem Nockenteil (9a) am Festelement (9) im Eingriff steht, und wobei der Nockenfolger (7a) des Zylinderelements (7) und das Nockenteil (8c) des beweglichen Nockentubus (8) derart im Eingriff stehen, dass ein Bewegen des Nockentubus (8) durch den Antriebsring (10) das Zylinderelement (7) veranlasst, sich zusammen mit dem Nockentubus (3) und dem linear beweglichen Führungstubus (4) in Richtung der optischen Achse zu bewegen.

2. Objektiv nach Anspruch 1, ferner umfassend eine dritte Linseneinheit (5), die konfiguriert ist, sich in Richtung der optischen Achse zu bewegen,

wobei der erste Nockentubus ein an der Innenumfangsfläche des ersten Nockentubus gebildetes und zum Bewegen der dritten Linseneinheit in Richtung der optischen Achse konfiguriertes drittes Nockenteil (3c) enthält, und
wobei der linear bewegliche Führungstubus (4) die dritte Linseneinheit in Richtung der optischen Achse führt.

3. Abbildungsvorrichtung mit einem Objektiv nach einem der Ansprüche 1 oder 2.

Revendications

1. Appareil d'objectif comprenant :

une première unité de lentilles (1) configurée pour maintenir une première lentille et pour qu'elle soit mobile dans une direction de l'axe optique ;
une deuxième unité de lentilles (2) configurée pour maintenir une deuxième lentille agencée plus près de l'image que la première lentille et pour qu'elle soit mobile dans la direction de l'axe optique ;
un premier tube à came (3) configuré de façon qu'il puisse être mis en rotation autour de l'axe optique, le premier tube à came comprenant une première partie formant came (3a) et une deuxième partie formant came (3b), la première partie formant came venant en prise avec la première unité de lentilles sur une surface circonférentielle extérieure du premier tube à came, et la deuxième partie formant came (3b) venant en prise avec la deuxième unité de lentilles sur une surface circonférentielle intérieure du premier tube à came ;
un tube de guidage se déplaçant linéairement (4) comprenant une première partie de mise en prise (4a) et une deuxième partie de mise en prise (4b), la première partie de mise en prise venant en prise avec la première unité de lentilles (1) sur une face extérieure du tube de guidage se déplaçant linéairement (4), et la deuxième partie de mise en prise (4b) venant en prise avec la deuxième unité de lentilles (2) sur une face intérieure du tube de guidage se déplaçant linéairement (4),
une plaque de guidage (6) ;
un élément de cylindre (7) agencé sur une face circonférentielle extérieure du premier tube à came (3) et de la première unité de lentilles (1), l'élément cylindrique (7) comprenant un galet suiveur (7a) ; et
un tube à came mobile (8) ayant une partie formant came (8c) formée sur la surface circonférentielle intérieure du tube à came mobile (8) et un galet suiveur (8b) formé sur la surface circonférentielle extérieure du tube à came mobile (8), et une protubérance de transmission de rotation (8a) formée sur la surface circonférentielle extérieure du tube à came mobile (8),
dans lequel le premier tube à came (3) vient en prise avec la surface circonférentielle intérieure du tube à came mobile (8) au niveau d'une partie formant protubérance (3d) afin qu'il puisse être mis en rotation de manière solidaire avec celle-ci ;
dans lequel le premier tube à came (3) et l'élément de cylindre (7) peuvent être mis en rotation l'un par rapport à l'autre par l'intermédiaire d'une structure de baïonnette et sont reliés l'un à l'autre de façon qu'ils soient mobiles de manière solidaire dans la direction de l'axe optique,
dans lequel, sur une face circonférentielle intérieure de l'élément de cylindre (7), les première et deuxième parties de mise en prise (4a, 4b) et les première et deuxième parties formant cames (3a, 3b) sont configurées pour guider les première et deuxième unités de lentilles dans la direction de l'axe optique tout en les empêchant de tourner autour de l'axe optique,
dans lequel la plaque de guidage (6) est fixée à un élément fixe (9) afin qu'elle soit mobile dans la direction de l'axe optique tout en étant empêchée de tourner autour de l'axe optique, et est agencée, par une structure de baïonnette, afin qu'elle soit mobile de manière solidaire avec, et qu'elle puisse être mise en rotation par rapport au tube à came mobile (8),
dans lequel le tube à came mobile (8) est agencé sur une face circonférentielle intérieure de l'élément fixe (9) ayant une partie formant came (9a),

la protubérance de transmission de rotation (8a) étant conçue pour venir en prise avec une bague d'entraînement (10) et le galet suiveur (8b) étant conçu pour venir en prise avec la partie formant came (9a) sur l'élément fixe (9), et
dans lequel le galet suiveur (7a) de l'élément cylindrique (7) vient en prise avec la partie formant came (8c) du tube à came mobile (8) de façon que le mouvement du tube à came mobile (8) produit par la bague d'entraînement (10) amène l'élément cylindrique (7) à se déplacer dans la direction de l'axe optique en association avec le premier tube à came (3) et le tube de guidage se déplaçant linéairement (4).

2. Appareil d'objectif selon la revendication 1, comprenant en outre une troisième unité de lentilles (5) configurée pour se déplacer dans la direction de l'axe optique,
dans lequel le premier tube à came comprend une troisième partie formant came (3c) formée sur la surface circonférentielle intérieure du premier tube à came et configurée pour déplacer la troisième unité de lentilles dans la direction de l'axe optique, et
dans lequel le tube de guidage se déplaçant linéairement (4) guide la troisième unité de lentilles dans la direction de l'axe optique.

3. Appareil de formation d'image comprenant un appareil d'objectif selon l'une quelconque des revendications 1 ou 2.

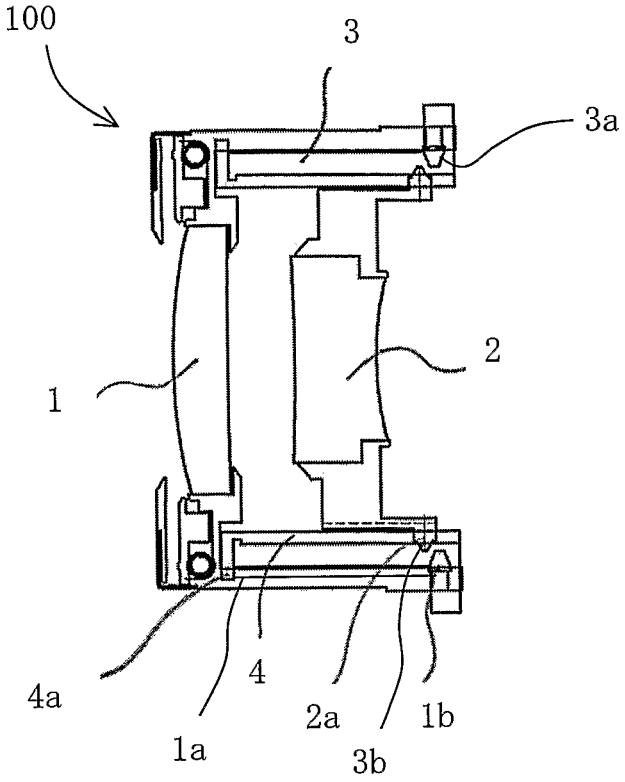


FIG. 1

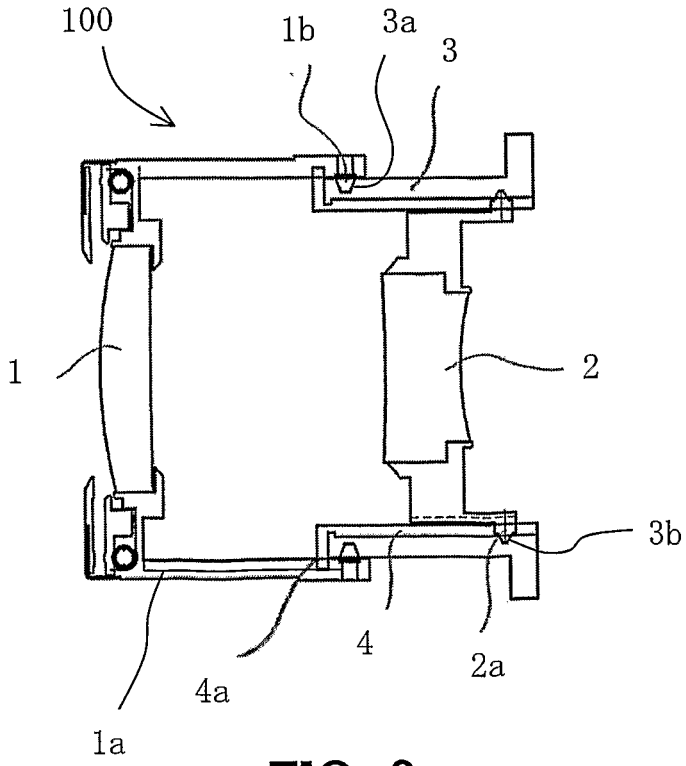


FIG. 2

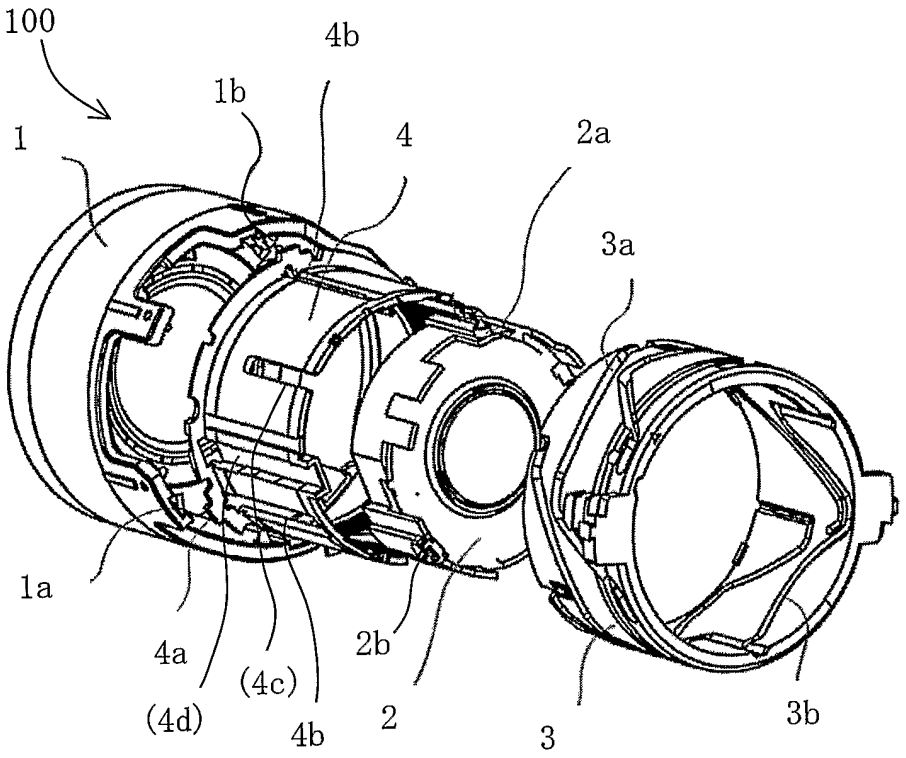

100
4b
1b
1
4
2a
3a
1a
4a
(4c)
2b
(4d)
4b
2
3
3b

FIG. 3

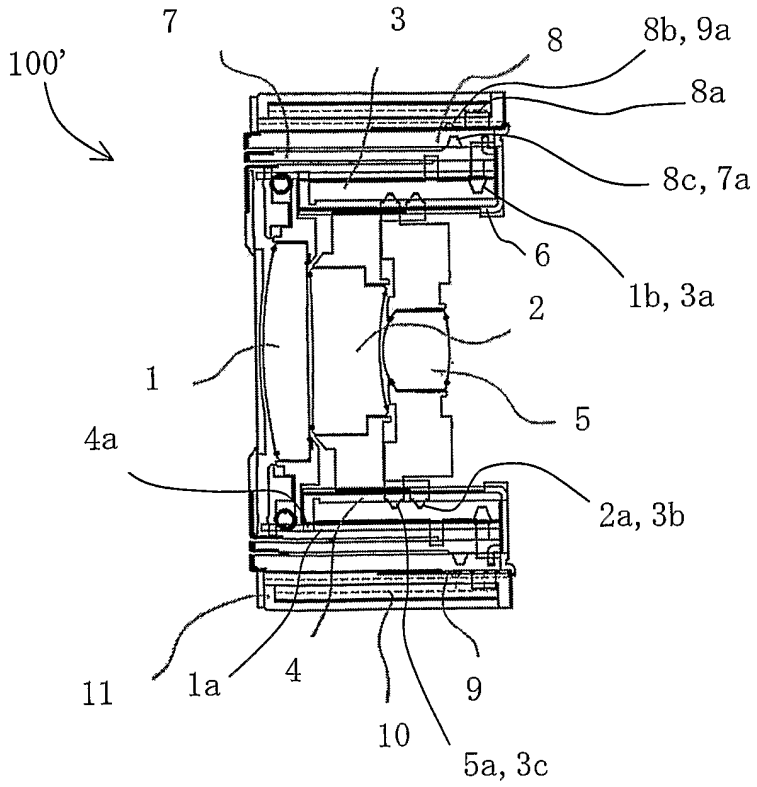

7
3
8
8b, 9a
100'
8a
8c, 7a
6
1b, 3a
2
1
5
4a
2a, 3b
11
1a
4
9
10
5a, 3c

FIG. 4

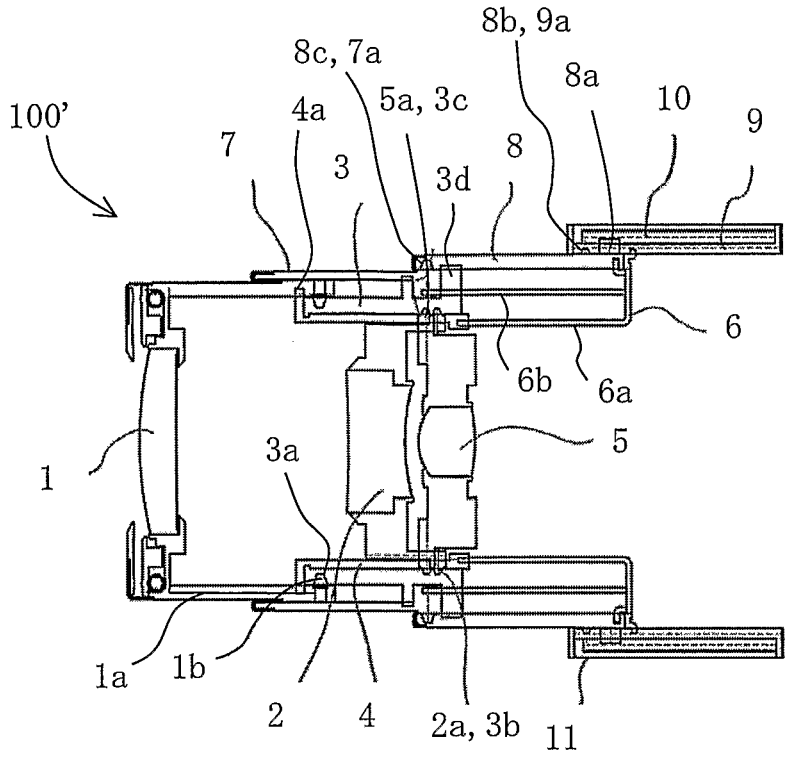

100'
7
4a
8c, 7a
5a, 3c
3
3d
8
8b, 9a
8a
10
9
6
6b
6a
5
1
3a
1a
1b
2
4
2a, 3b
11

FIG. 5

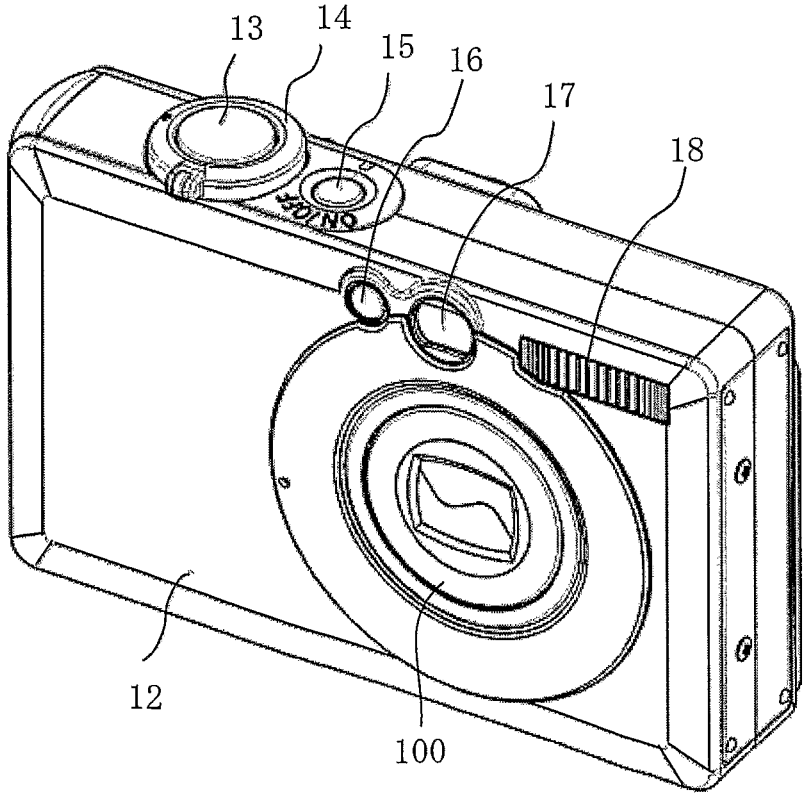

13
14
15
16
17
18
12
100

FIG. 6

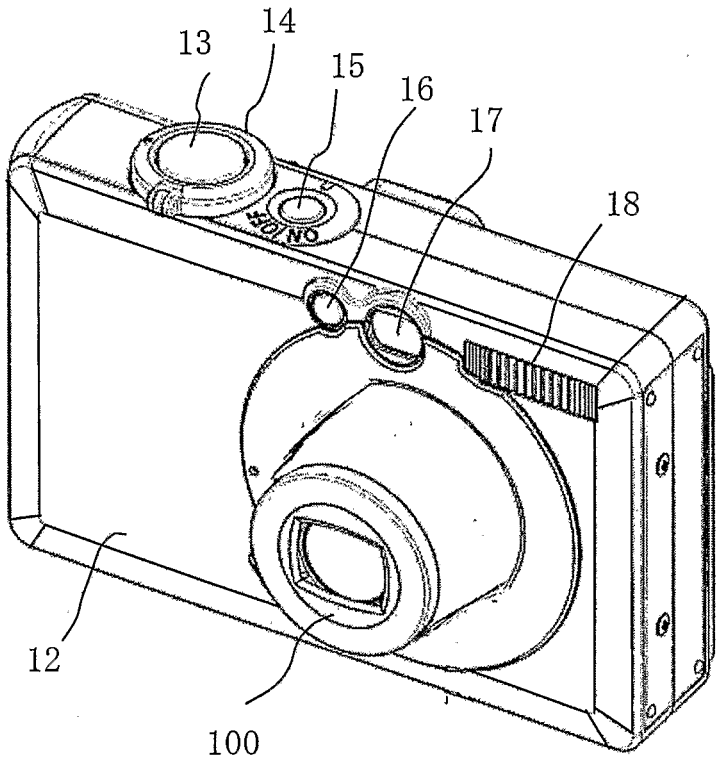


FIG. 7

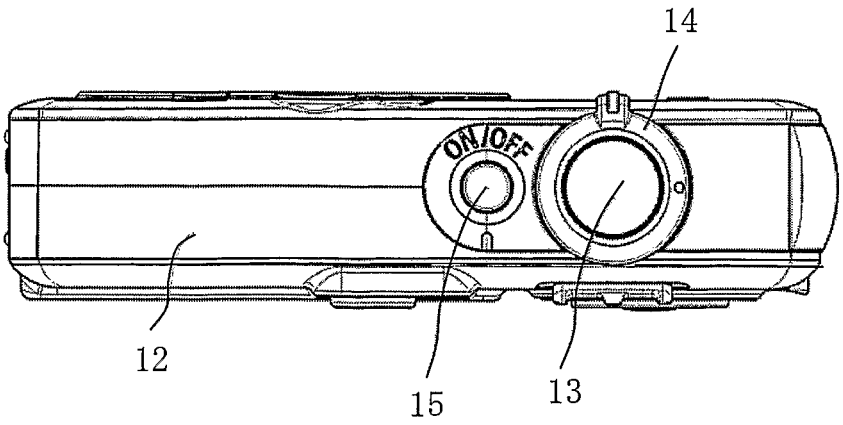


FIG. 8

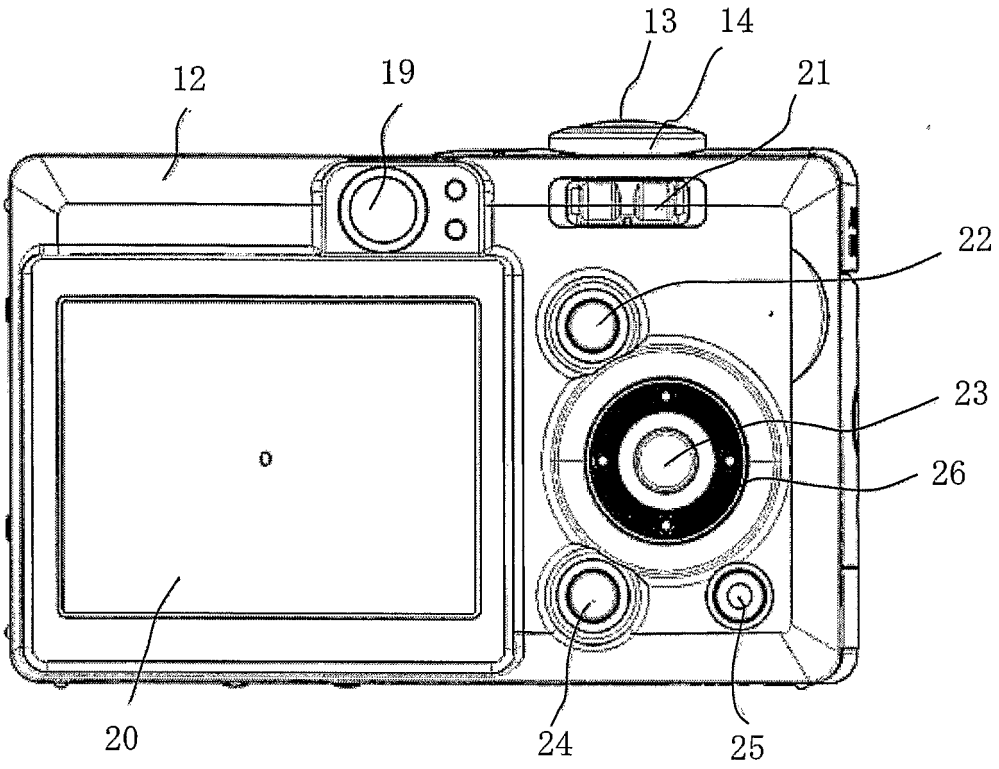


FIG. 9

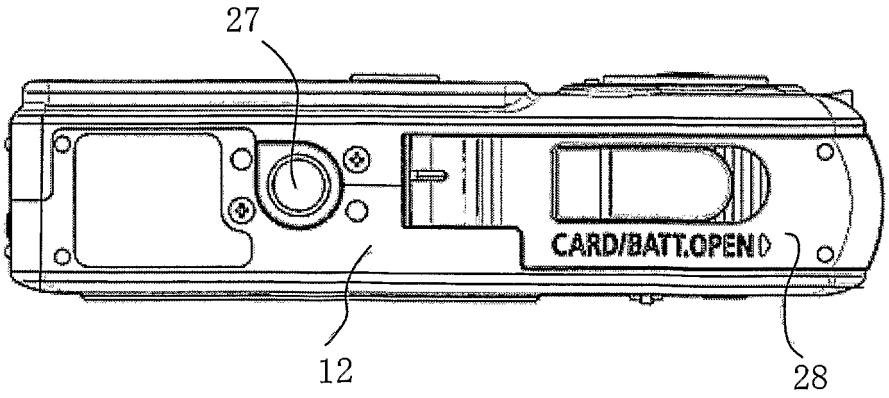


FIG. 10

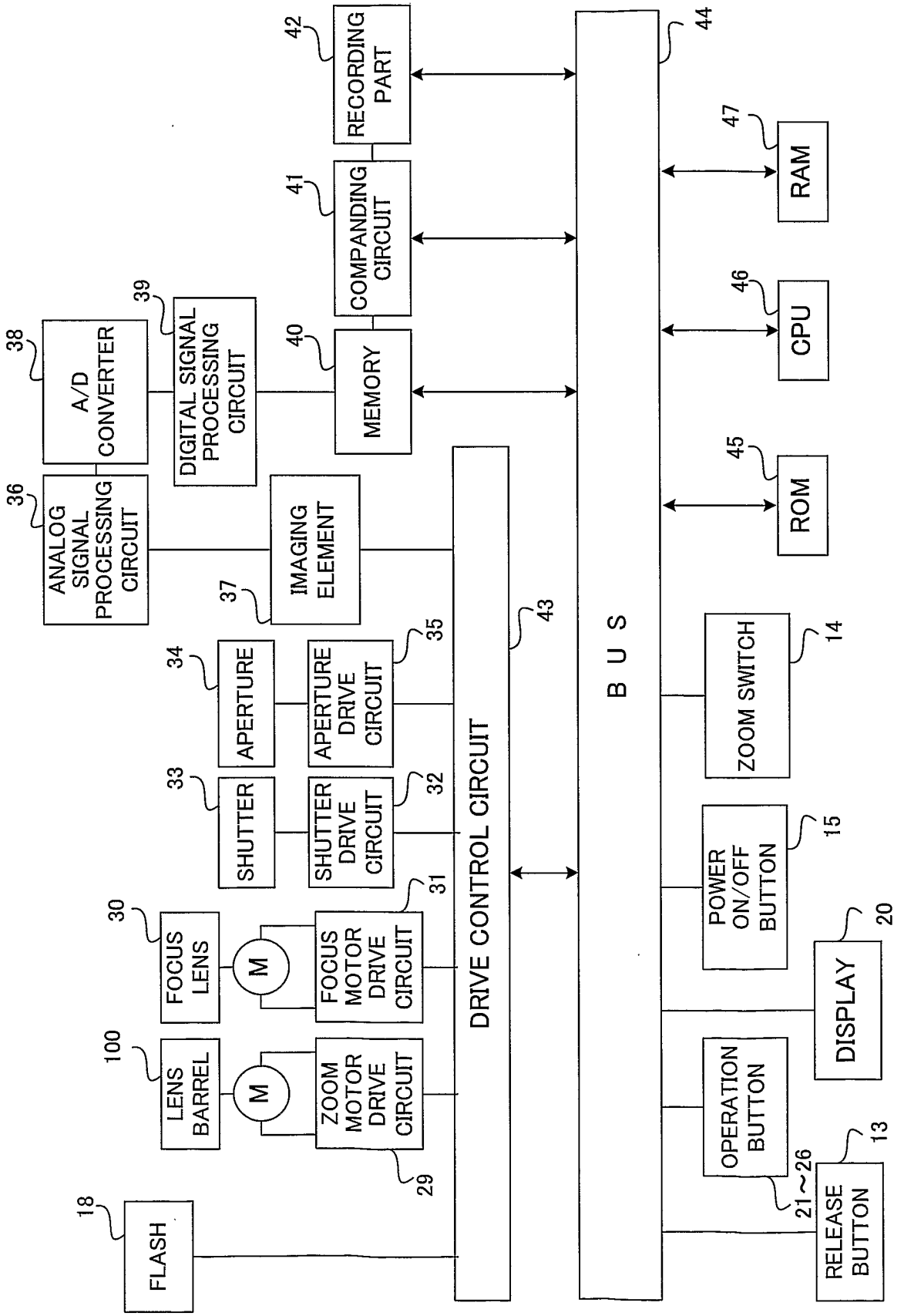

RECORDING PART
42
COMPANDING CIRCUIT
41
MEMORY
40
DIGITAL SIGNAL PROCESSING CIRCUIT
39
A/D CONVERTER
38
ANALOG SIGNAL PROCESSING CIRCUIT
36
IMAGING ELEMENT
37
APERTURE
34
APERTURE DRIVE CIRCUIT
35
SHUTTER
33
SHUTTER DRIVE CIRCUIT
32
FOCUS LENS
30
FOCUS MOTOR DRIVE CIRCUIT
31
LENS BARREL
100
ZOOM MOTOR DRIVE CIRCUIT
29
FLASH
18
DRIVE CONTROL CIRCUIT
43
B U S
44
RAM
47
CPU
46
ROM
45
ZOOM SWITCH
14
POWER ON/OFF BUTTON
15
DISPLAY
20
OPERATION BUTTON
21~26
RELEASE BUTTON
13
M
M

FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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